Future developments in the UK food composition tables

By D. H. Buss and D. D. Singer, *Food Science Division, Ministry of Agriculture, Fisheries and Food, Horseferry Road, London SW1P 2AE*

In man, one of the classical ways of assessing nutritional adequacy is by means of dietary surveys. Such surveys nevertheless have a number of limitations, including: (1) the groups available for study may not be ideal for the purpose, (2) even if a full 7 d weighed survey is done, the diet may not be properly recorded or it may have been altered by participation in the survey, (3) the nutritional value of the diet may be incorrectly assessed if inappropriate food composition tables are used, and (4) the yardsticks for assessing the results (e.g. recommended dietary allowances, heights and weights or biochemical indices) may be of limited relevance or too insensitive to be useful.

The present paper addresses the third of these limitations. As the Ministry of Agriculture, Fisheries and Food (MAFF) has long used food composition tables for assessing its own policies and surveys, and is now expanding and updating the standard tables in this country (Paul & Southgate, 1978), we would like to describe the MAFF's involvement in this work in some detail before outlining future developments.

History and continuity

The UK government's first involvement with the analysis of nutrients in foods was during the First World War. Captain Plimmer, who was attached to the War Office, analysed almost 900 British foods for energy, water, fat, protein, carbohydrate and ash, and, where appropriate, sodium chloride, starch and sugars, and crude fibre. The values were subsequently published in a book (Plimmer, 1921). This work was necessary because previous food tables had covered only German (Rubner, 1901) and American (Atwater & Bryant, 1906) foods.

Through the Medical Research Council (MRC), the government supported Drs McCance and Widdowson who analysed many more foods in the 1920s and 1930s. This led to the first two editions of their *Chemical Composition of Foods* (McCance & Widdowson, 1940, 1946), with the second also including values for wartime foods from the Ministry of Food to give proximates and minerals (but still no vitamins) in some 600 foods. These were the first tables anywhere to include cooked dishes—indeed, cooked dishes represented one-fifth of the foods, with such traditional delicacies as jam roll, treacle tart and sago, semolina, tapioca and suet puddings, as well as oatmeal biscuits (economy version), scrambled egg using dried eggs, and potato pastry.

The 3rd edition (McCance & Widdowson, 1960) was followed 18 years later by the fourth (Paul & Southgate, 1978) which includes almost 1,000 foods and mixed dishes, a wide range of minerals and vitamins for each, and supplementary tables on fatty acids, amino acids and cholesterol. This last publication was produced jointly by MAFF and the MRC under the auspices of the Ministry's Committee on Food Composition, and it includes many analyses done especially for the purpose in the Laboratory of the Government Chemist (LGC). Since that time, MAFF has been the only inheritor of this tradition.

The need for further updating: new foods

The 4th edition (Paul & Southgate, 1978) has served nutritionists, dietitians and others well for 10 years, but needs to be updated to include new manufactured foods such as

extruded maize, potato and wheat snacks, oven chips, coated- and crumbed-chicken products, semi-skimmed milks, yoghurt drinks, new cheeses such as Lymeswold®, cream liqueurs, and fish canned in brine. There is also a rapidly increasing range of products advertized as containing less salt, sugar or fat or more fibre than before, which could be included, although it would not be practicable to analyse them all, especially those that may prove transient. The inclusion of too many such items would also greatly increase the size and cost of the tables. We shall, however, encourage manufacturers to include their own information, suitably identified and regularly updated, in the computerized data-bank (see p. 188) wherever possible.

Numerous fresh foods such as kiwi fruit, satsumas, courgettes, beansprouts, mange-tout peas and pistachio nuts should also be included. Although there are values for some of these in the supplement on *Immigrant Foods* (Tan *et al.* 1985), more analyses are still required except where values can safely be taken from food composition tables from other countries (West, 1985).

In addition, many of the values in the 4th edition (Paul & Southgate, 1978) may no longer be appropriate. For example, cornflakes now have added vitamins B_6, B_{12} and D as well as iron, thiamin, riboflavin and niacin; bread is made from new varieties of wheat with less protein; meat is leaner; and the values for potatoes and most other common vegetables and fruit were for the varieties available in the 1930s. Furthermore, many fruits and vegetables can now be obtained all year round from countries such as Greece, Israel and New Zealand, whereas they used to come only from the local farm for 1 or 2 months of the year, and this may affect their composition.

Finally, many new continental and other increasingly popular cooked dishes need to be included, if possible after cooking both by traditional methods and with microwaves.

New nutrients and new analytical methods

The coverage of nutrients also needs extension, for the present tables do not include many individual sugars, *trans*-fatty acids, selenium, iodine or several other nutrients of current interest. Nor do they show individual carotenes or tocopherols, which, with improved analytical methods are becoming easier to analyse. In addition, the values for fibre may be quite different from those now accepted by many physiologists and which will be needed for food labelling. A single example will suffice: in the 4th edition (Paul & Southgate, 1978) cornflakes are said to have 110 g dietary fibre/kg yet their non-starch polysaccharide content is only 6·5 g/kg (Englyst *et al.* 1983). Other methods give different values again (Table 1).

Development of the new food tables: new analyses

The lack of analyses and of the systematic collection of literature data for 10 years after publication of the 3rd edition (McCance & Widdowson, 1960) meant that there was an

Table 1. *Dietary fibre content of cornflakes, as determined by different methods (g/kg) (from Cummings* et al. *1985)*

Method	Mean	Range	*n*
1	7·1	0·2 – 105·3	9 × 2
2	14·4	2·8 – 40	20 × 2
3	43·1	22·7 – 98·8	12 × 2
4	43·9	39·6 – 53·3	7 × 1
5	196·2	0·0 – 789·4	16 × 2

(Means calculated after discarding statistical outliers and bad replicates).

enormous amount to do when work started on the 4th edition (Paul & Southgate, 1978). To ensure that this would not happen again, MAFF initiated in the 1970s a rolling programme of analyses mainly at the LGC and the Institutes of Food Research in Norwich and Reading. We have also recruited and trained qualified nutritionists (first Mrs Lorna Sivell and now, with the Royal Society of Chemistry (see p. 188) Miss Bridie Holland) to review all new publications on the nutrients in food, to assess them for their validity for the purpose and for their relevance to the UK, and to collate them.

The rolling programme has achieved much already (Paul *et al.* 1986). Bread and flour, human milk, cow's milk, butter, cream, cheese and other dairy products, eggs, potatoes and immigrant foods have all been studied; and the nutrients looked at in some detail have included zinc, copper, Se, manganese, I, fluoride, chromium and fibre. More recent analyses have covered beverages, fish, fruit and vegetables and their products, and individual sugars and carotenoids in foods. Later we shall extend the studies of form and availability to other nutrients and address nutrient losses on cooking. Where appropriate, this may be done in collaboration with other countries (particularly where we have foods in common).

This work has sometimes been very detailed. For example, our studies of bread (Wenlock *et al.* 1985) included the proximates, ten minerals and six vitamins in separate samples not only of the major types of bread in seven different regions of Britain (to indicate regional differences), but also in twenty-seven other types of bread including representative samples of wrapped and unwrapped small and large loaves, different wheatgerm breads, French bread, hamburger buns and so on. The study on milk at Reading (Scott *et al.* 1984) covered twelve main areas of Britain month-by-month for 1·5 years; and that on potatoes in Norwich (Finglas & Faulks, 1984) looked at four different maincrop varieties and 'earlies' from a range of outlets in London, Birmingham and Glasgow over two whole years. This gives much more information than fits easily into traditional food tables, so how best to present it? Occasionally we have been asked to give ranges for each nutrient, but, as Table 2 shows, typical (not mean) values for more detailed subdivisions of the food are more likely to be useful for most people. However, the more foods and nutrients we include, the more likely there are to be values missing from the tables, which can cause problems for the unwary user (Black *et al.* 1985).

Developments in publishing and data processing

We plan to publish further supplements to update and expand the 4th edition (Paul & Southgate, 1978) rather than wait the 5 years or more that it would take to finalize a

Table 2. *Ranges for vitamin C content of old potatoes (mg/kg raw edible portion) (from Finglas & Faulks, 1984)*

All	62 – 276
By variety:	
Pentland Crown	71 – 197
King Edward	62 – 276
Desiree	71 – 201
Maris Piper	79 – 166
By season:	
June – July	62 – 89
March – April	71 – 84
January	75 – 101
October	140 – 276

https://doi.org/10.1079/PNS19880029 Published online by Cambridge University Press

completely new 5th edition (although there may be a 5th edition in due course). The next supplement will address cereal products, and will be published by the Royal Society of Chemistry (RSC) in 1988. It will be followed by one on dairy products and another showing detailed information on the fatty acid content of foods.

In addition to the printed tables, the MAFF also produced the information from the 4th edition (Paul & Southgate, 1978) in machine-readable form on a series of paper tapes. Although the information was in a format that made it difficult for it to be transferred into a useful computer system, all the copies were sold long ago. It is known, however, that in spite of protection by Crown Copyright, the number of computer systems on which the information is mounted far exceeds the number of tapes sold. Computer software has also been sold together with the copyrighted information, and some organizations have freely copied it to others.

Apart from the legal aspects, these practices have had a number of unfortunate repercussions. Not only did the information on the tapes contain errors which have been perpetuated in the disseminated packages, but since it has been the practice of many, if not most, users of the computerized information to add their own records, the original MAFF and MRC information has been indiscriminately mixed with other information of variable value, often without the current user's knowledge.

Within MAFF, the information was first transferred to a Wang 2200 series machine, and corrections made. As more information became available (see, for example, Paul *et al.* 1986), it was added to new databases especially constructed for the analysis of specific MAFF surveys. Construction of a further comprehensive database to incorporate all the information, like the compilation of comprehensive tables of food composition, is a more complex and specialized task than is sometimes recognized. As matters stood about 5 years ago, neither the Information, Computing and Statistics Branch nor the Nutrition Branch of MAFF's Food Science Division had the resources to complete these tasks unaided. It was therefore necessary to seek external aid if the information was to be made more generally available.

Collaboration between the MAFF and the RSC

If the MAFF was to engage in any useful arrangements with a third party it was essential for long-term agreements to be sought and made. MAFF was also expecting not to bear all the costs involved. After preliminary negotiations with a number of bodies, MAFF commissioned the RSC to undertake a market survey, in which they would ascertain how any new book or computerized information might be most useful and so most likely to be self-supporting. The result of this survey was promising, and the RSC has now agreed to carry out the necessary tasks in the future and has been licensed to do so by H.M. Stationery Office.

The costs involved over the next 6–10 years will be high, and it is essential not only that these be recovered but also for there to be sufficient margin of profit for the RSC to be able to continue the work after this time. As a natural outcome, users of the computerized information must expect to register with the RSC and to observe the copyright laws. In return they can expect a variety of services including regular updates and membership of user-groups, such as are common in other areas. Furthermore, since some users of the information require more information than others about the provenance of the samples, the analytical methods, literature references and other matters, it is likely that the RSC, with the agreement of MAFF, will provide information at whatever level of detail is required on request, albeit with separate financial arrangements. The precise nature and extent of all these new services will be publicized as soon as they have been finalized.

It is not intended that these new arrangements should prevent the development of computer software for sale by third parties. Although the RSC will market recommended software packages for use by dietitians and others, they also expect to issue licences to other software writers. Similarly, although they will be publishing the information in other forms (e.g. for schools), licences to authors wishing to incorporate the information into their own works should also be possible.

International collaboration

Epidemiologists studying diet-related diseases, and many others, may need compatibility between food composition tables originating in different countries. As far as possible, the new UK tables will observe INFOODS guidelines (see, for example, Greenfield & Southgate, 1988), particularly with respect to the machine-readable format. However, the complexities of the problems involved must render full integration a distant prospect.

A further development is the additional coding of the UK tables according to the 'facetted' system devised by the US Department of Agriculture (Harris *et al.* 1984). This system unequivocally describes foods as a series of alphanumeric terms. For example,

A101B1201C235E134F18G003H100H101H147H158H247J135K03M188N36N42P24,

represents black cherry yoghurt made from pasteurized cow's milk with added sugar, black cherry juice and natural flavours but with less than 1·5% fat and packed in a plastic container. Only the computer programmer needs to be concerned with such complex codes, for as far as the user is concerned they will be transparent. However, this coding, together with appropriate computer software, should enable extraction from food tables of highly specific information; for example, of all fat-reduced foods containing added vitamins A and D, or of all canned green vegetables with added colours. In order to promulgate the development of this useful system the US National Cancer Institute is recoding information from the American food composition tables (US Department of Agriculture, 1976–1986), and nutritionists from Australia, Canada, Denmark and France have also recently agreed to participate in this development.

Conclusion

Finally, we would wish to remind users of the printed and the computerized tables that food composition information must not be regarded in the same light as the fundamental and immutable physical constants. The variations between samples and between analytical methods, together with those arising from geographical, seasonal and storage factors, make all the values very 'fuzzy'. Few, perhaps, are valid beyond the second significant figure, but as the use of computers becomes more universal, the risks of users neglecting the explanatory text becomes higher and the information could become increasingly misapplied. It is the intention of all producers of food composition tables to protect users from this trap as far as possible, and we are playing our part, with our international colleagues, to help everyone to have the best possible information for as many uses as possible.

REFERENCES

Atwater, W. O. & Bryant, A. P. (1906). *The Chemical Composition of American Food Materials. Bulletin* no. 28. Washington, DC: US Office of Experiment Stations.

Black, A. E., Paul, A. A. & Hall, C. (1985). *Human Nutrition:Applied Nutrition* **39A**, 19–22.

Cummings, J. H., Englyst, H. N. & Wood, R. (1985). *Journal of the Association of Public Analysts* **23**, 1–35.

Englyst, H. N., Anderson, V. & Cummings, J. H. (1983). *Journal of the Science of Food and Agriculture* **34**, 1434–1440.

Finglas, P. M. & Faulks, R. M. (1984). *Journal of the Science of Food and Agriculture* **35**, 1347–1356.

Greenfield, H. & Southgate, D. A. T. (1988). *Guidelines for the Production, Management and Use of Food Composition Data – an INFOODS Manual* (In the Press).

Harris, L. E., Butrum, R. R. & Sorenson, A. W. (1984). *Journal of the American Dietetic Association* **84,** 1210–1215.

McCance, R. A. & Widdowson, E. M. (1940). *The Chemical Composition of Foods*. London: H.M. Stationery Office.

McCance, R. A. & Widdowson, E. M. (1946). *The Chemical Composition of Foods*, 2nd ed. London: H.M. Stationery Office.

McCance, R. A. & Widdowson, E. M. (1960). *The Composition of Foods*, 3rd ed. London: H.M. Stationery Office.

Paul, A. A. & Southgate, D. A. T. (1978). *McCance & Widdowson's The Composition of Foods*, 4th ed. London: H.M. Stationery Office.

Paul, A. A., Southgate, D. A. T. & Buss, D. H. (1986). *Human Nutrition:Applied Nutrition* **40A,** 287–299.

Plimmer, R. H. A. (1921). *Analyses and Energy Values of Foods*. London: H.M. Stationery Office.

Rubner, M. (1901). *Zeitschrift für Biologie* **42,** 261.

Scott, K. J., Bishop, D. R., Zechalko, A., Edwards-Webb, J. D., Jackson, P. A. & Scuffam, D. (1984). *Journal of Dairy Research* **51,** 37–50.

Tan, S. P., Wenlock, R. W. & Buss, D. H. (1985). *Immigrant Foods*. London: H.M. Stationery Office.

US Department of Agriculture (1976–1986). *Composition of Foods, Raw, Processed, Prepared*. Washington, DC: US Government Printing Office.

Wenlock, R. W., Sivell, L. M., King, R. T., Scuffam, D. & Wiggins, R. A. (1985). *Journal of the Science of Food and Agriculture* **34,** 1302–1318.

West, C. [editor] (1985). *Annals of Nutrition and Metabolism* **29,** Suppl. 1.

Printed in Great Britain